CLAIMS

What is claimed is:

1.   A method of solving satisfiability problems, the method comprising:

(a)   organizing a plurality of clauses in a satisfiability problem as a chronologically ordered stack comprising a top and a bottom, wherein newly deduced conflict clauses are added to the top of the stack;

(b)   selecting a branching variable from a plurality of unassigned variables in the satisfiability problem;

(c)   assigning value 0 or 1 to the selected branching variable;

(d)   marking literals set to 0;

(e)   invoking Boolean Constraint Propagation when the stack comprises one or more unit clauses;

(f)   repeating (b)-(e) when the stack only comprises one or more non-unit clauses; and

(g)   returning a solution if a solution is found.

2.   The method of claim 1, wherein the stack comprises at least one initial clause and at least one conflict clause.

3.   The method of claim 2, wherein at least one initial clause is located below the at least one conflict clause in the stack.

4.   The method of claim 1, wherein the branching variable is selected from among a set of unassigned variables in the clause on top of the stack when the top clause is a conflict clause.

5.   The method of claim 1, further comprising:

maintaining an activity counter for each unassigned variable.

6.   The method of claim 5, wherein the activity counter of an unassigned variable is incremented each time the unassigned variable appears in a clause used when generating a conflict clause.

7.   The method of claim 5, wherein the selected branching variable comprises an activity counter with the highest value.

8. , The method of claim 5, wherein the activity counters are periodically divided by a constant greater than one.

9.   The method of claim 1, wherein whether 0 or 1 is assigned to the selected branching variable depends upon costs associated with the positive and negative literals of this variable.

10.   The method of claim 9, wherein the cost of a literal is equal to the total number of conflict clauses containing the literal.

11.   The method of claim 9, wherein the cost of a literal is equal to the total number of binary clauses containing the literal plus, for each binary clause containing the literal, the total number of binary clauses containing an opposite of the other literal in the binary clause.

12.   The method of claim 9, wherein, if there is at least one unsatisfied conflict clause, the selected branching variable is assigned value 1 if the cost associated with the positive literal of this variable is higher than the cost associated with the negative literal.

13.   The method of claim 9, wherein, if there is at least one unsatisfied conflict clause, the selected branching variable is assigned value 0 if the cost associated with the negative literal of this variable is higher than the cost associated with the positive literal.

14.   The method of claim 9, wherein, if all conflict clauses are satisfied, the selected branching variable is assigned value 0 if the cost associated with the positive literal of this variable is higher than the cost associated with the negative literal.

15. The method of claim 9, wherein, if all conflict clauses are satisfied, the selected branching variable is assigned value 1 if the cost associated with the negative literal of this variable is higher than the cost associated with the positive literal.

16. The method of claim 1, further comprising:

maintaining an activity counter for each conflict clause; and

removing one or more conflict clauses from the stack.

17. The method of claim 16, wherein the activity counter of a conflict clause is incremented each time this conflict clause is used when generating another conflict clause.

18. The method of claim 16, wherein at least one of the one or more conflict clauses removed from the stack is near the bottom of the stack.

19. The method of claim 18, wherein at least one removed conflict clause comprises more than eight literals.

20. The method of claim 18, wherein at least one removed conflict clause comprises an activity counter with a value less than sixty.

21. The method of claim 16, wherein at least one of the one or more conflict clauses removed from the stack is near the top of the stack.

22. The method of claim 21, wherein at least one removed conflict clause comprises more than forty-two literals.

23. The method of claim 21, wherein at least one removed conflict clause comprises an activity counter with a value less than seven.

24. The method of claim 16, wherein the one or more unsatisfied conflict clauses removed from the stack do not include the clause at the top of the stack.

25.   The method of claim 16, wherein no less than a specified part of the conflict clauses in the stack are removed.

26.   The method of claim 16, wherein the top conflict clause of the stack is never removed.

27.   The method of claim 1, further comprising:

invoking reverse Boolean Constraint Propagation when a conflict arises;

deducing a new conflict clause; and returning the answer "no solution" if this clause is empty or adding the newly deduced conflict clause to the top of the stack otherwise.

28.   The method of claim 27, wherein a conflict arises when all literals in one of the plurality of clauses are set to 0 as a result of one or more assignments of value.

29.   The method of claim 27, wherein backtracking is non-chronological.

30.   The method of claim 1, further comprising:

starting a new search tree when more than a threshold number of conflict clauses have been deduced or more than a threshold number of unit conflict clauses have been deduced.

31.   A computer readable medium storing instructions, which, when executed by a processing system, cause the system to perform a method of solving satisfiability problems, the method comprising:

(a)   organizing a plurality of clauses in a satisfiability problem as a chronologically ordered stack comprising a top and a bottom, wherein newly deduced conflict clauses are added to the top of the stack;

(b)   selecting a branching variable from a plurality of unassigned variables in the satisfiability problem;

(c)   assigning value 0 or 1 to the selected branching variable;

(d)   marking literals set to 0;

(e)   invoking Boolean Constraint Propagation when the stack comprises one or more unit clauses;

(f)   repeating (b)-(e) when the stack only comprises one or more non-unit clauses; and

(g)   returning a solution if a solution is found.

32.   The medium of claim 31, wherein the stack comprises at least one initial clause and at least one conflict clause.

33.   The medium of claim 32, wherein at least one initial clause is located below the at least one conflict clause in the stack.

34.   The medium of claim 31, wherein the branching variable is selected from among a set of unassigned variables in the clause on top of the stack when the top clause is a conflict clause.

35.   The medium of claim 31, the method further comprising:
         maintaining an activity counter for each unassigned variable.

36.   The medium of claim 35, wherein the activity counter of an unassigned variable is incremented each time the unassigned variable appears in a clause used when generating a conflict clause.

37.   The medium of claim 35, wherein the selected branching variable comprises an activity counter with the highest value.

38.   The medium of claim 35, wherein the activity counters are periodically divided by a constant greater than one.

39.   The medium of claim 31, wherein whether 0 or 1 is assigned to the selected branching variable depends upon costs associated with the positive and negative literals of this variable.

40.   The medium of claim 39, wherein the cost of a literal is equal to the total number of conflict clauses containing the literal.

41.   A system for solving satisfiability problems, the system comprising:

means for organizing a plurality of clauses in a satisfiability problem as a chronologically ordered stack comprising a top and a bottom, wherein newly deduced conflict clauses are added to the top of the stack;

means for selecting a branching variable from a plurality of unassigned variables in the satisfiability problem;

means for assigning value 0 or 1 to the selected branching variable;

means for marking literals set to 0;

means for invoking Boolean Constraint Propagation when the stack comprises one or more unit clauses;

means for repeating the selecting, assigning, marking, and invoking when the stack only comprises one or more non-unit clauses; and

means for returning a solution if a solution is found.

42.   The system of claim 41, wherein the stack comprises at least one initial clause and at least one conflict clause.

43.   The system of claim 42, wherein at least one initial clause is located below the at least one conflict clause in the stack.

44.   The system of claim 41, wherein the branching variable is selected from among a set of unassigned variables in the clause on top of the stack when the top clause is a conflict clause.

45.   The system of claim 41, further comprising:

means for maintaining an activity counter for each unassigned variable.

46.   The system of claim 45, wherein the activity counter of an unassigned variable is incremented each time the unassigned variable appears in a clause used when generating a conflict clause.

47.   The system of claim 45, wherein the selected branching variable comprises an activity counter with the highest value.

48.   The system of claim 45, wherein the activity counters are periodically divided by a constant greater than one.

49.   The system of claim 41, wherein whether 0 or 1 is assigned to the selected branching variable depends upon costs associated with the positive and negative literals of this variable.

50.   The system of claim 49, wherein the cost of a literal is equal to the total number of conflict clauses containing the literal.